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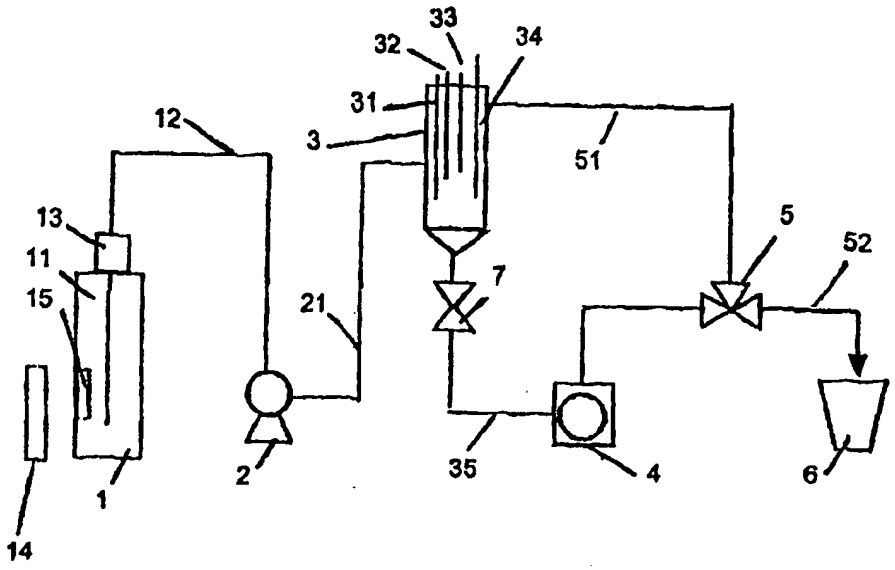

(57) Abstract

A precision dispenser for liquids consisting of: a first pump (2) fed by a flask (1) containing liquid, connected thereto via an attachment (13) provided with a suction tube (16); an intermediate reservoir (3) fed by the first pump (2) and provided with one or more level probes (31-33); a second, high-precision, pump (4) downstream of said reservoir (3); a three-way solenoid valve (5) set downstream of the pump (4), from which it receives the liquid at input, and having two output ways, one output leading to the reservoir (3) and the other leading to a final receptacle (6) for collecting the liquid delivered; and a microprocessor unit for control and management of the pumps (2, 4), probes (31-33) and maintenance functions.

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PRECISION DISPENSER FOR LIQUIDS

Field of the invention and prior art

The present invention regards a precision dispenser for controlled delivery of liquid products, in particular methadone or other medicinal preparations.

In the current state of the art, dispensers of liquid methadone are known in which a pre-set amount of liquid is taken from a feed reservoir by means of a peristaltic pump. The dose of liquid is then poured into a glass to be taken by the patient.

These known dispensers are moreover generally managed by a computer for identification and management of the administrations envisaged for the various patients.

However, the known dispensers present a number of drawbacks linked in particular to the precision that they are able to provide in dosing, this aspect being of particular consequence in the administration of methadone, both on account of the importance and delicacy of the cases treated, and on account of the need for being able to certify exactly the amounts of methadone actually supplied.

Scope of the invention

A prime purpose of the present invention is therefore to provide a dispenser for liquid products, and in particular methadone, that affords high precision both in dosing and in calculating the quantities handled during operation.

Summary of the invention

The above purpose has been achieved according to the invention with a dispenser of liquid methadone, in which the hydraulic circuit comprises a sector for circulation of the liquid handled. The circulation makes it possible to set initial conditions that can be repeated in an identical manner at each new delivery. The circuit is moreover provided with an intermediate reservoir which is distinct from the supply flask and serves as a bleeder for possible air bubbles and has a check point for checking the amount of liquid present in the circuit, as well as for checking the temperature conditions.

The hydraulic circuit according to the invention comprises a first pump, preferably a peristaltic pump, which is fed by an interchangeable flask containing liquid and sends the liquid on to an intermediate reservoir. The output of the latter is connected, via a manual valve, to a second, high-precision, pump, preferably of

the piston type, and subsequently to a three-way solenoid valve, which has one output connected to the intermediate reservoir and the other output connected to the final receptacle of the amount of liquid to be delivered. The intermediate reservoir is equipped with level probes, and possibly with a temperature probe.

A first advantage is represented by the high precision achievable and the assurance of being able to repeat delivery of liquid with identical circuit starting conditions.

A second advantage is represented by the possibility of maintaining the liquid in movement when the device is not in use, so preventing any possible precipitation or separation of various phases.

These and other advantages will emerge more clearly from the ensuing description and from the annexed drawings, which are provided as a non-limiting example.

Brief description of the drawings

- Figure 1 shows a diagram of the dispenser according to the invention;
- Figures 2.1, 2.2, 2.3, and 2.4 present a flowchart showing the various phases of the method according to the invention, in which P1 stands for Peristaltic pump, P2 stands for Piston pump, EV stands for Solenoid valve, S2 stands for Intermediate tank, M2 stands for Maximum level of S2. In particular, figures 2.1 and 2.2 relate to the filling and maintenance of level in intermediate reservoir (Routine 01) and figures 2.3 and 2.4 relate to the charging of circuit of main pump (Routine 02); and
- Figures 3a and 3b present, respectively, a side view and a top view of a flask for the apparatus of Figure 1.

Detailed description of the invention

With reference to the attached figures, a dispenser according to the invention is made up of:

- a first pump 2, for example a peristaltic pump, fed, via pipes 12, by an interchangeable flask 1 containing liquid;
- an intermediate reservoir 3 fed, via pipes 21, by the first pump 2 and provided with one or more level probes 31-33, and possibly a temperature probe 34;
- a second, high-precision, pump 4, preferably of the type with one or more pistons, fed, via pipes 35 and valve 7, by the said reservoir 3;

- a three-way valve 5, set downstream of the pump 4, from which it receives the liquid at input, and having two output ways, one output leading, via pipes 51, to the reservoir 3, and the other leading, via further pipes 52, to a final receptacle 6 for collecting the liquid to be delivered; and
- a microprocessor unit for control and management of the pumps 2, 4, of the maintenance functions and of the probes 31-34.

According to the invention, and as may be seen from the attached drawings, the part of the hydraulic circuit between the reservoir 3 and the solenoid valve 5 makes up a circulation circuit H, in which the liquid can be made to circulate by means of the pump 4 and the three-way valve 5.

During operation, the pump 2 sucks up liquid from the flask 1 and sends it into the reservoir 3 until an appropriate level is reached (which is subsequently maintained), this being detected by the probes 31-33. If the level is sufficient, the pump 4 starts to circulate the liquid until it ensures complete filling of the pipes.

At the first request for delivery, the control unit opens the valve 5 for delivery (hence, of course, closing the circulation way) for the period of delivery of the amount of liquid required.

Advantageously, in the example described the pump is a piston-type pump (TRAVCYL®, MODEL 16, manufactured by Encynova International Inc.), which is operated by a stepper motor and in which, at every cycle of known duration, the amount of liquid displaced is known exactly.

In the event of pauses in use between successive deliveries that might cause changes in the state of the liquid or deviations with respect to the pre-set start-of-delivery conditions, the pump 4 carries out a predetermined number of cycles.

In order to guarantee the exact repetition of each delivery, the pump 4 is moreover provided with means for the determination of an initial zero, from which to start measurement of the amount being delivered. According to the invention, the pump 4 is then reset at each delivery and is brought back to a start-of-delivery position.

The above-mentioned means consist of an electromagnetic proximity sensor which acts as reference for the stroke of the pump piston and which controls advance of the stepper motor.

In the case where the dispenser is to be used for delivery of liquid methadone, it is

particularly important to guarantee complete delivery of the liquid contained in the flasks and, in addition, to ensure that it is possible to check also management of the flasks with certainty.

With reference to Figures 3a and 3b, the flasks according to the invention consist of a main body 1 provided with a threaded neck 8 for connection to a seal-type packing plug. The neck is moreover provided with teeth 81 for the bayonet joint of a coupling 13 for connection with the hydraulic circuit of the apparatus.

The bottom of the flask consists of a pair of surfaces 9, 91, which are slightly inclined and which converge into a hemispherical cup 93 which forms the lowest point of storage of the liquid in the flask.

A fin 92 is provided underneath the surface 9 to guarantee horizontal support for the flask in its housing on the apparatus.

In order to ensure that the suction tube 16 always draws from the minimum-level point of the cup 93, the tube is advantageously made so that it is integral with the attachment 13, which in turn finds a secure top reference point in the bayonet connection.

The flask 1 is further equipped with means of identification 12, which may be read by appropriate sensors 14 of the dispenser.

In a preferred embodiment, the said means 12 are of the RFID radio-frequency type, according to a recognition technique which is in itself already known, whilst the corresponding sensors 13 are fixed to the apparatus and connected to the control unit of the apparatus, which checks the volumes and the destination of the amounts delivered.

With reference to Figures 2.1 – 2.4, the invention further comprises a method for precision dosing of liquids, in particular by means of a dispenser of the type described above.

The method comprises the following steps:

- check of the control probes and sensors of the dispenser;
- charging, for example by means of a peristaltic pump fed by a flask containing the liquid to be delivered, of an intermediate reservoir S2 up to a maximum level M2 (routine 01) detected by a level probe;
- charging of a circulation circuit operated by a main pump P2 (routine 02), for

example of the piston type, the circuit extending from the reservoir S2 up to a delivery valve EV;

- in the case of a command for first delivery, charging of the spout of the flask for feeding the liquid, and search for a zero point of the pump; for subsequent deliveries with the same flask, search for the zero point of the pump;
- opening of the delivery valve EV and operation of the pump P2;
- execution of routine 01 for check on level of the reservoir S2;
- check on the amount delivered: if it corresponds to the amount envisaged, interruption of delivery and closing of the delivery valve EV; and
- waiting for new command for delivery.

In addition, in the event of prolonged inactivity between successive deliveries, according to the method the circulation routine 02 is carried out to prevent any possible modifications in the state of the liquid (separation of phases, formation of air bubbles, etc.) present in the circuit of the pump 4.

The present invention has been described with reference to a preferred embodiment thereof, but it is understood that equivalent modifications may be made by a person skilled in the branch without thereby departing from the sphere of protection granted to the present patent for industrial invention.

CLAIMS

1. A precision dispenser for liquids consisting of:
- a first pump (2), fed by a flask (1) containing liquid, connected by means of an attachment (13) provided with a suction tube (16);
- an intermediate reservoir (3) fed by the first pump (2) and provided with one or more level probes (31-33);
- a second, high-precision, pump (4) downstream of said reservoir 3;
- a three-way solenoid valve (5), set downstream of the pump (4), from which it receives the liquid at input, and having two output ways, one output leading to the reservoir (3), and the other leading to a final receptacle (6) for collecting the liquid to be delivered; and
- a microprocessor unit for control and management of the pumps (2, 4), of the probes (31-34) and of the maintenance functions.

2. A dispenser according to Claim 1, characterized in that the part of the hydraulic circuit between the reservoir (3) and the solenoid valve (5) forms a circulation circuit H in which the liquid can be circulated by means of the pump (4) and the three-way valve (5).

3. A dispenser according to Claim 2, characterized in that the pump (4) is of the type with one or more pistons, operated by a stepper motor.

4. A dispenser according to Claim 1, characterized in that it comprises means for seeking a zero point of start of each delivery of the pump (4).

5. A dispenser according to Claim 4, characterized in that the said means are constituted by a proximity sensor capable of detecting the position of the pistons of the pump and controlling advance of the stepper motor.

6. A dispenser according to Claim 1, characterized in that it comprises means (14) for identifying the flask of liquid used.

7. A dispenser according to Claim 6, characterized in that the said means are RFID sensors.

8. A dispenser according to Claim 1, characterized in that it comprises a temperature probe (34).

9. A dispenser according to Claim 1, characterized in that the said suction tube

(16) is integral with the said attachment (13).

10. A flask for liquids, for use in dispensers according to at least one of Claims 1-9, characterized in that it consists of a main body (1) provided with a threaded neck (8) equipped with means (81) for the press-block coupling of an attachment (13) of a dispenser, in which the bottom of the flask consists of a pair of surfaces (9, 91), which are inclined and which converge centrally into a cup (93) forming the lowest point of storage of the liquid in the flask (1).

11. A flask according to Claim 10, characterized in that the said means (81) consists of a bayonet coupling.

12. A flask according to Claim 10, characterized in that a fin (92) is provided underneath the surface (9) to guarantee horizontal support for the flask in its housing on the dispenser.

13. A flask according to Claim 10, characterized in that it is equipped with means of identification (12), which may be read by appropriate means (14) of the dispenser.

14. A flask according to Claim 13, characterized in that the said means (12) are of the RFID type.

15. A flask according to Claim 10, characterized in that it is made of plastic material.

16. A method for dosing liquids, comprising the following steps:

- check of the control probes and sensors of the dispenser;
- charging, for example by means of peristaltic pump fed by a flask containing the liquid to be delivered, of an intermediate reservoir S2 up to a maximum level M2 (routine 01) detected by a level probe;
- charging of a circulation circuit operated by a main pump P2 (routine 02), for example of the piston type, the circuit extending from the reservoir S2 up to a multi-way delivery valve EV;
- in the case of a command for first delivery, charging of the spout of the flask for feeding the liquid, and search for a zero point of the pump; for subsequent deliveries with the same flask, search for the zero point of the pump;
- opening of the delivery valve EV and operation of the pump P2;
- execution of routine 01 for check on level of the reservoir S2;

- check on the amount delivered: if it corresponds to the amount envisaged, interruption of delivery and closing of the delivery valve EV; and
- waiting for new command for delivery.

17. Method according to Claim 16, in which in the event of prolonged inactivity between successive deliveries, the circulation routine 02 is carried out to prevent any possible modifications in the state of the liquid present in the circuit of the pump 4.

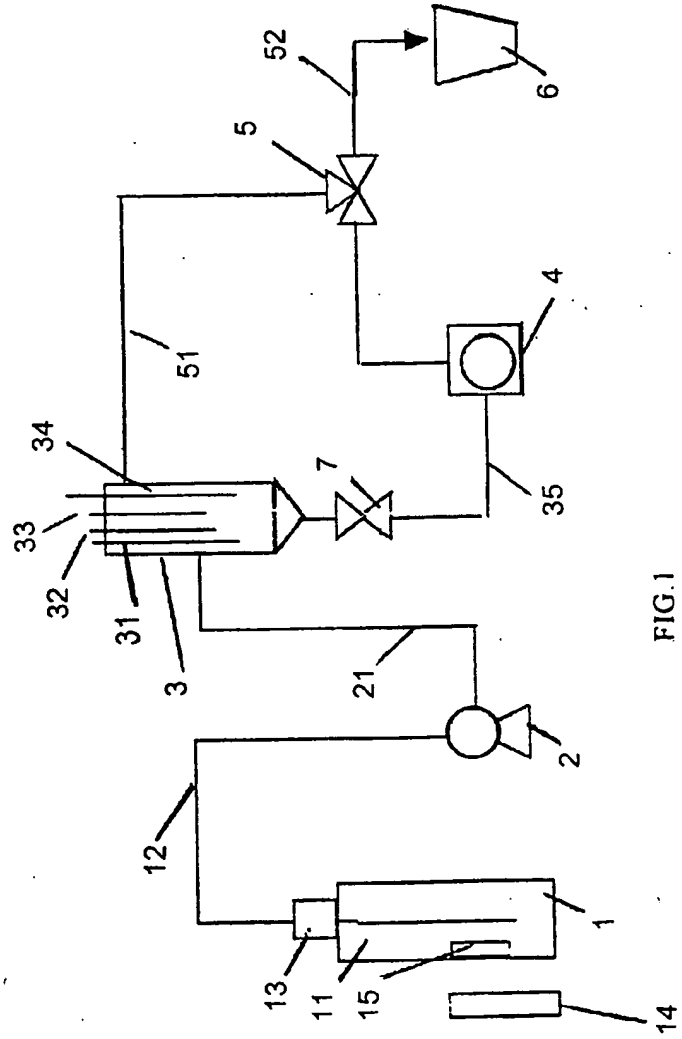

FIG.1

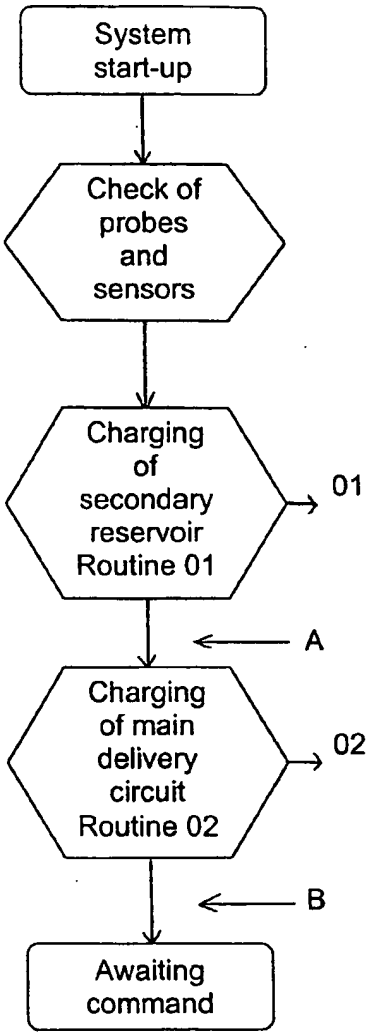
System start-up
Check of probes and sensors
Charging of secondary reservoir Routine 01
01
A
Charging of main delivery circuit Routine 02
02
B
Awaiting command

Figure 2.1

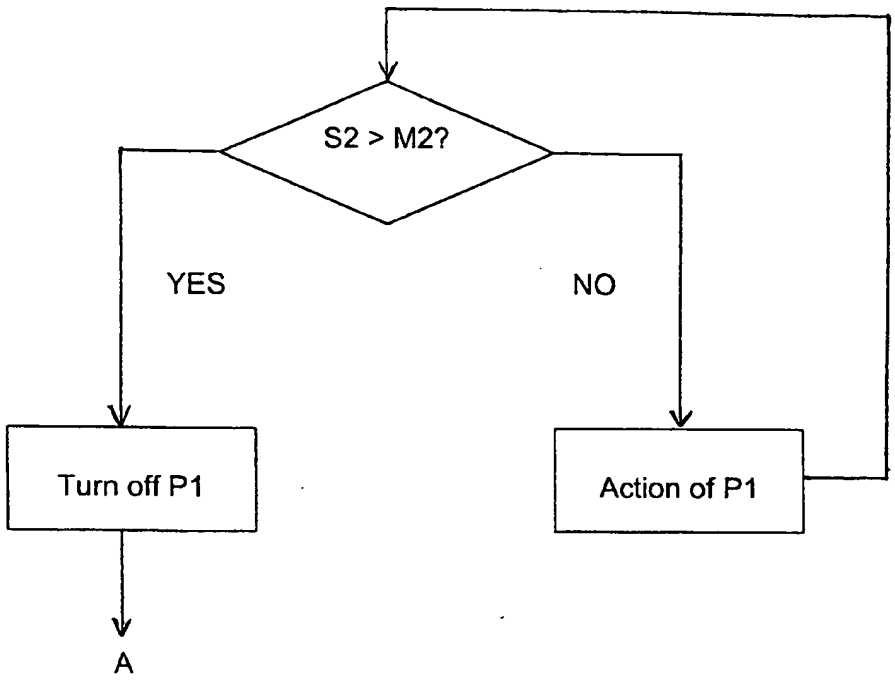

Figure 2.2

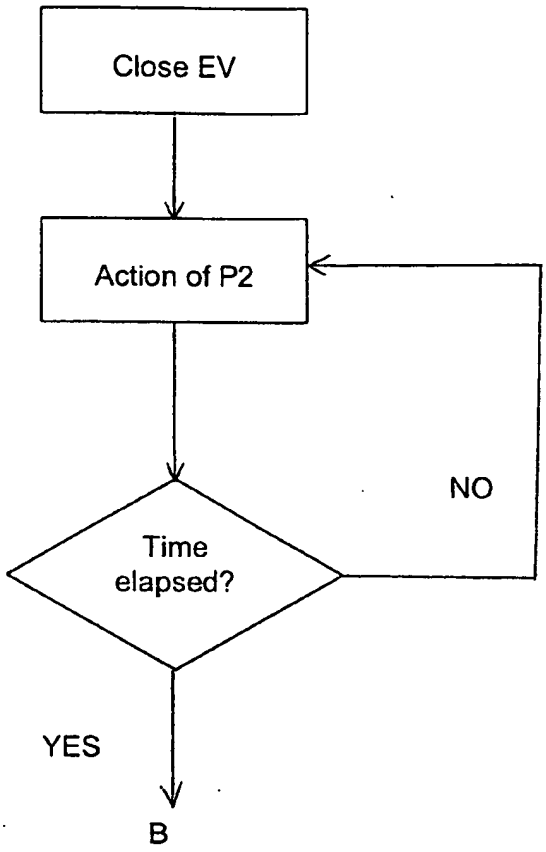

Figure 2.3

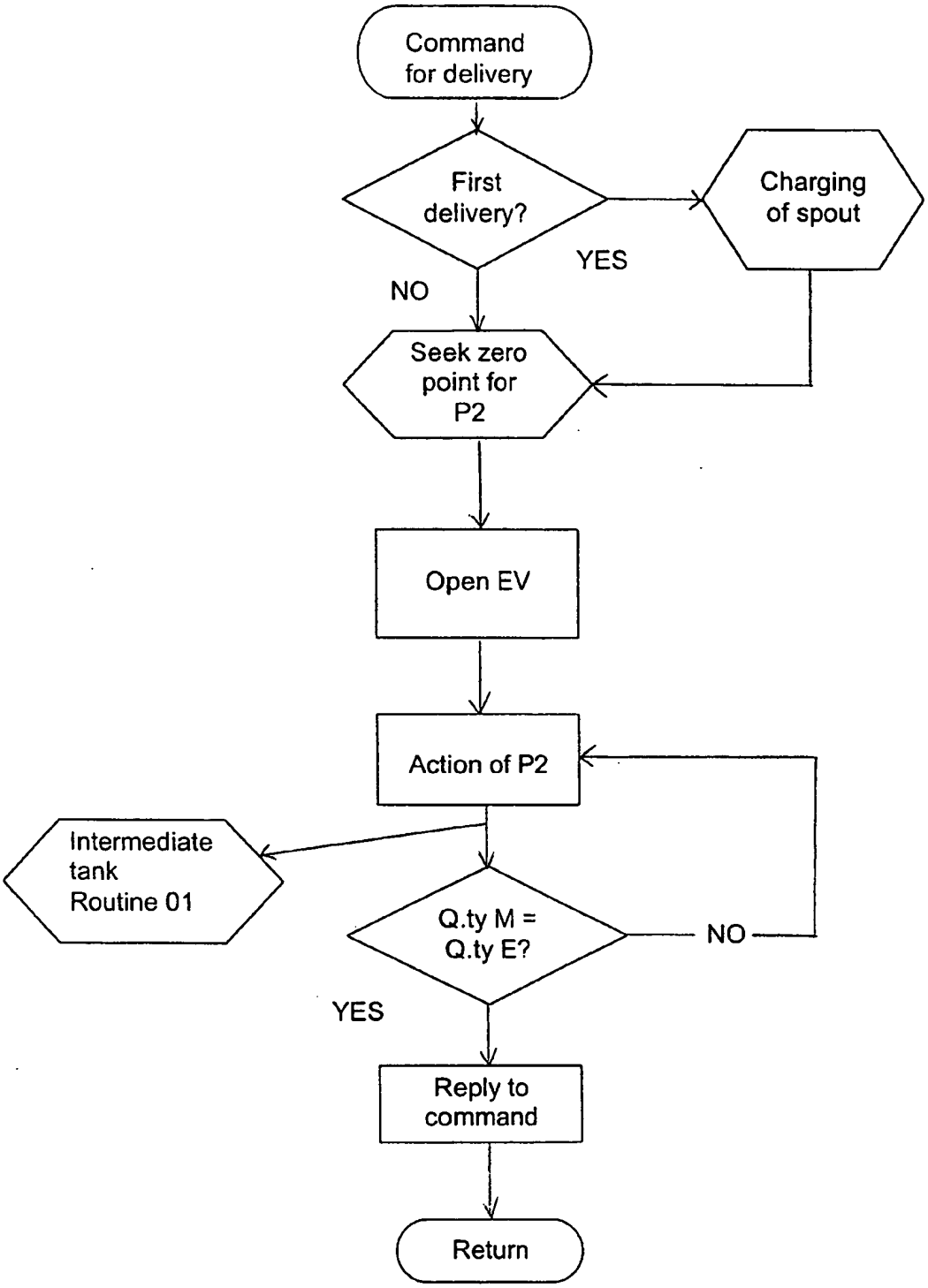
Command for delivery
First delivery?
YES
Charging of spout
NO
Seek zero point for P2
Open EV
Action of P2
Intermediate tank Routine 01
Q.ty M = Q.ty E?
NO
YES
Reply to command
Return

Figure 2.4

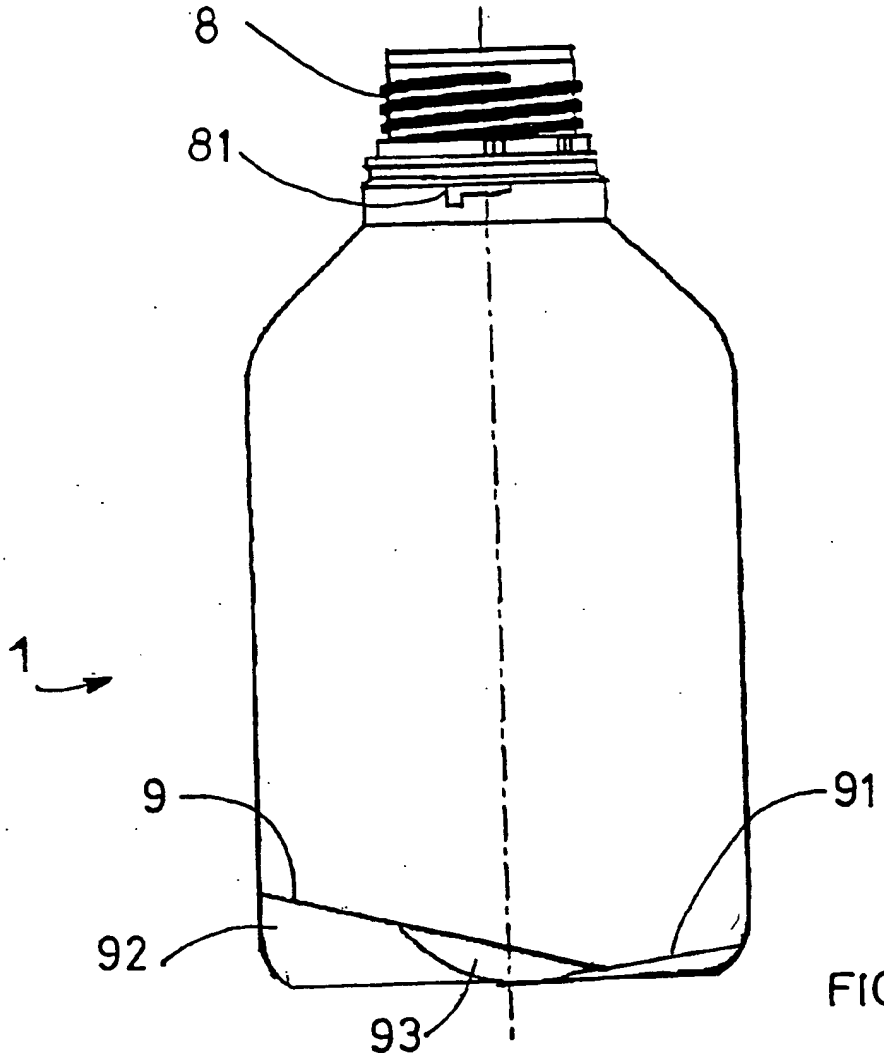

FIG.3a

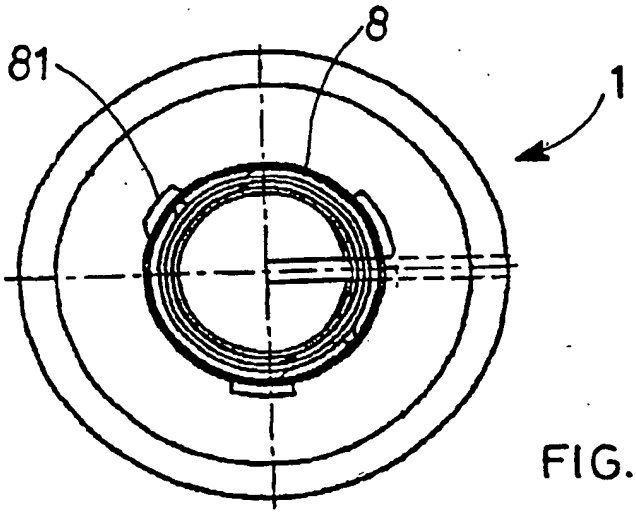

FIG.3b

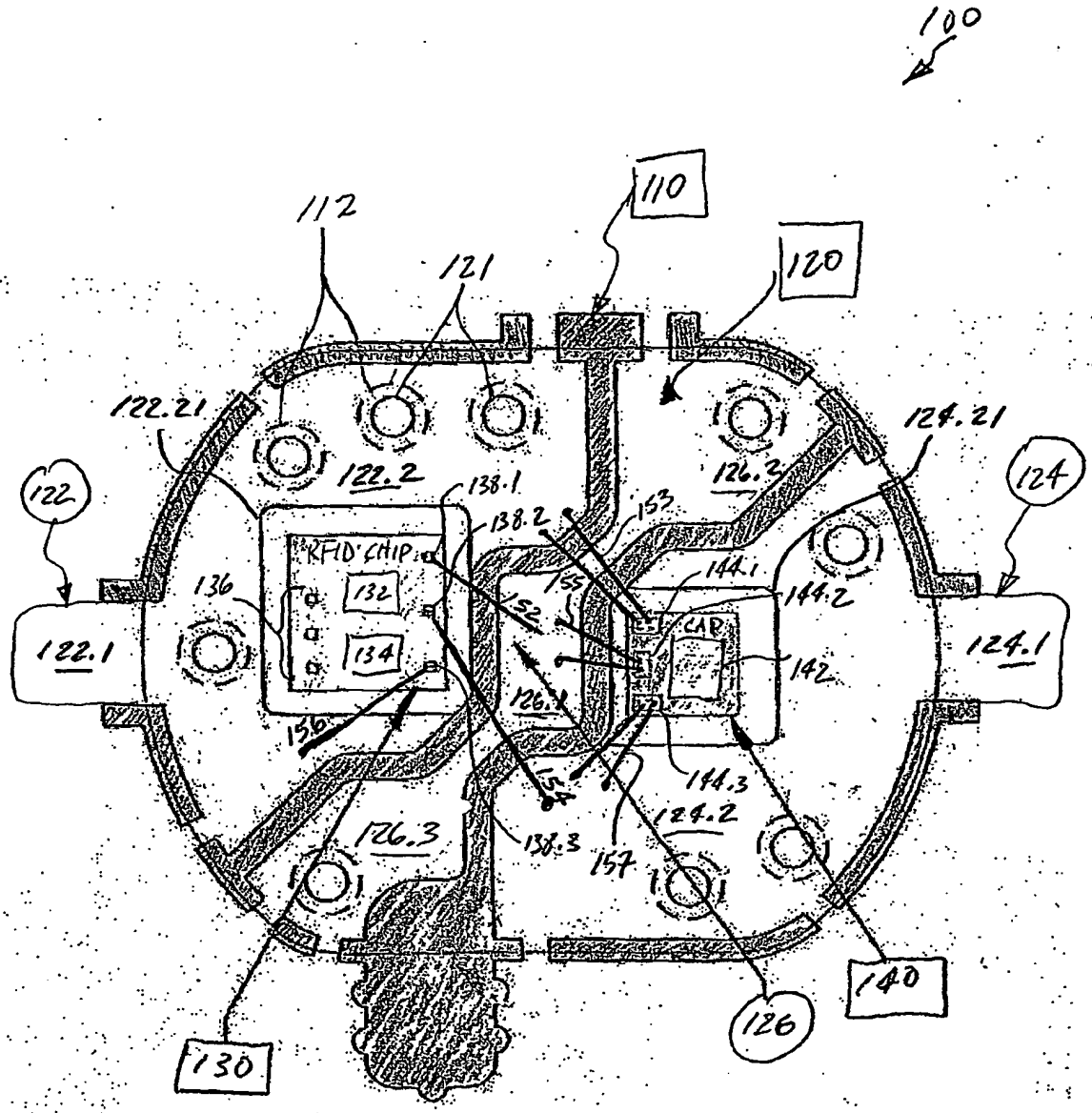

FIG. 1

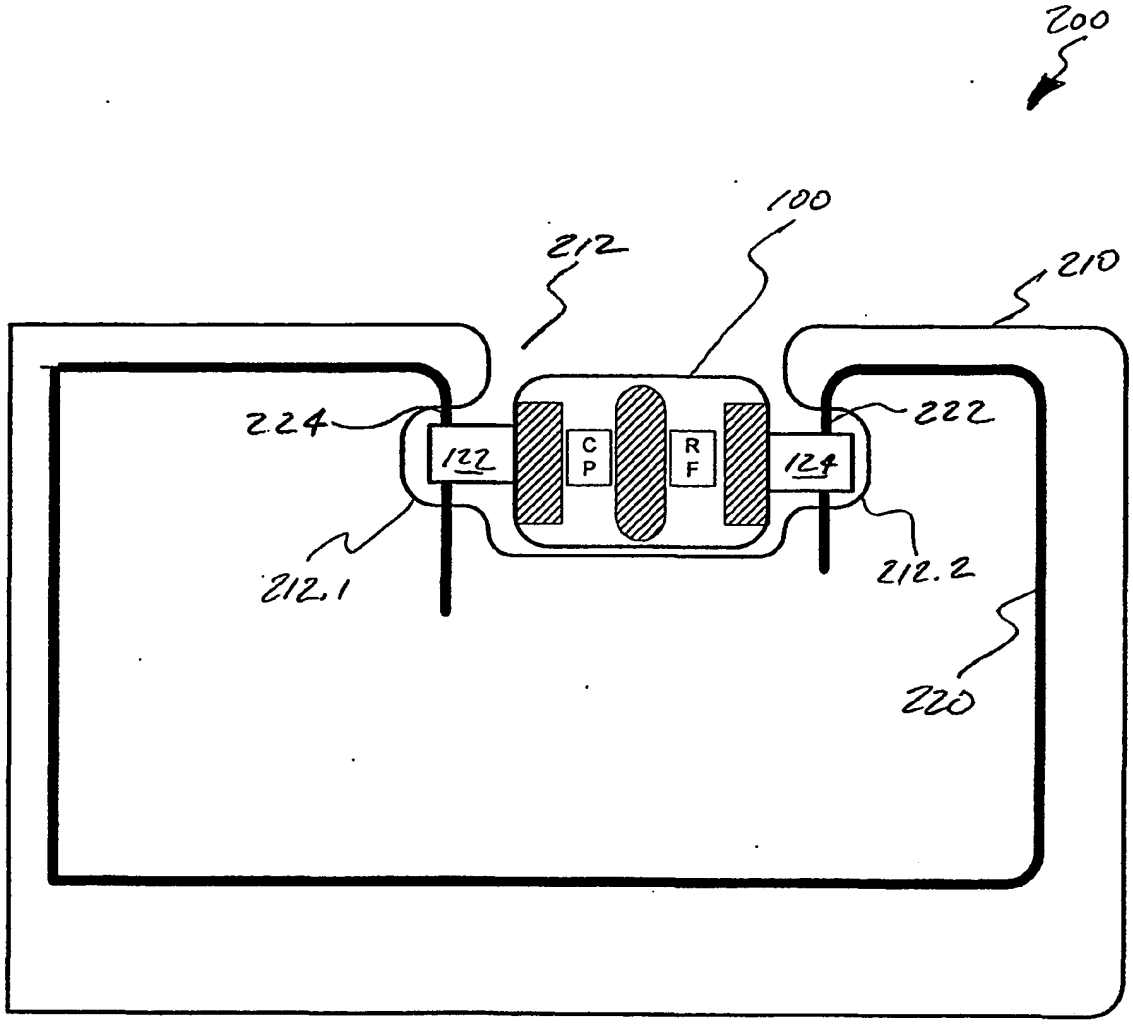

FIG. 2

300

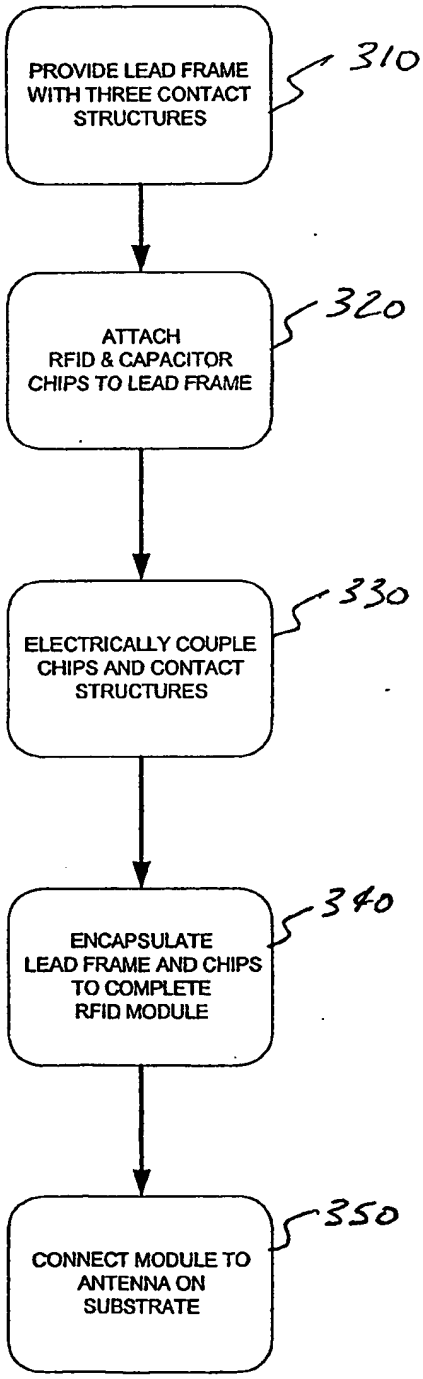
PROVIDE LEAD FRAME WITH THREE CONTACT STRUCTURES
310
ATTACH RFID & CAPACITOR CHIPS TO LEAD FRAME
320
ELECTRICALLY COUPLE CHIPS AND CONTACT STRUCTURES
330
ENCAPSULATE LEAD FRAME AND CHIPS TO COMPLETE RFID MODULE
340
CONNECT MODULE TO ANTENNA ON SUBSTRATE
350

FIG. 3